

06-01-00

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ATTORNEY'S DOCKET NO.  
2891.0390

PATENT APPLICATION

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APPLICATION FOR U.S. PATENT UNDER 37 C.F.R. § 1.53(b)  
TRANSMITTAL FORM

Box Patent Application  
ASSISTANT COMMISSIONER FOR PATENTS  
Washington, D.C. 20231

Sir:

Transmitted herewith for filing is the patent application of:

Inventor or Application Identifier:

E. Barton Manchester

Entitled:

METHOD AND SYSTEM FOR ACTIVATING A LINE CARD

Enclosed are:

- ☒ Specification ( 20 Total Pages)  
☒ Drawing(s) ( 2 Total Sheet(s) of ☒ Formal ☐ Informal)  
☒ Combined Declaration and Power of Attorney  
    ☒ Newly executed (original or copy)  
    ☐ Copy from a prior application  
        (for continuation/divisional only)

- ☒ An Assignment of the invention to Cisco Technology, Inc. is attached.  
A separate cover sheet in compliance with 37 C.F.R. § 3.28 and § 3.31 is included  
with an Assignment recordal fee of \$40.00 pursuant to 37 C.F.R. § 1.21(h).

☒ Certificate of Mailing

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Applicant is:

- ☒ Large Entity  
☐ Small Entity  
    ☐ Small Entity Statement enclosed  
    ☐ Small Entity Statement filed in prior application.  
        Status still proper and desired.

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PATENT APPLICATION

2

The accompanying application is:

☒ Original.

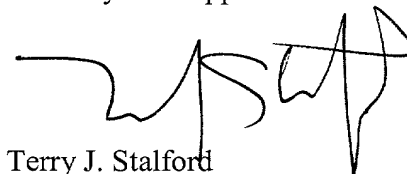
☐ Continuation ☐ Divisional ☐ Continuation-In-Part (CIP)

of prior application No. \_\_\_\_\_ which is hereby incorporated by reference therein.

| FEE CALCULATION    |        |       |                 |          | FEE       |
|--------------------|--------|-------|-----------------|----------|-----------|
|                    | Number |       | Number<br>Extra | Rate     | Basic Fee |
|                    |        |       |                 |          | \$ 690.00 |
| Total Claims:      | 28     | -20 = | 8               | X \$18 = | \$ 144.00 |
| Independent Claims | 4      | - 3 = | 1               | X \$78 = | \$ 78.00  |
| TOTAL FILING FEE = |        |       |                 |          | \$ 912.00 |

X Enclosed is a check in the amount of \$ 912.00 to satisfy filing fee requirements under 37 C.F.R. § 1.16. Please charge any additional fees or credit any overpayment to Deposit Account No. 02-0384 of BAKER BOTTS L.L.P. A duplicate copy of this sheet is enclosed.

Respectfully submitted,  
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: E. Barton Manchester  
Date Filed: May 30, 2000  
Title: METHOD AND SYSTEM FOR ACTIVATING A  
LINE CARD



**BOX PATENT APPLICATION**

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For Patents

Washington, D.C. 20231

Dear Sir:

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I hereby certify that the attached Application Transmittal Form, Patent Application, executed Declaration and Power of Attorney, two (2) sheets of Formal Drawings, Assignment, Assignment Cover Sheet, firm checks in the amount of \$912.00 to cover the application filing fee, and \$40.00 assignment recordation fee, and this Certificate of Mailing are being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 C.F.R. § 1.10 on this 30th day of May, 2000 and is addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231.

  
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062891.0390

PATENT APPLICATION

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METHOD AND SYSTEM FOR ACTIVATING A LINE CARD

TECHNICAL FIELD OF THE INVENTION

This invention relates generally to the field of telecommunications and more particularly to a method and system for activating a line card.

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BACKGROUND OF THE INVENTION

Telecommunications systems generally include modular line cards, in addition to one or more central cards. The line cards allow a variety of features to be incrementally added to the telecommunications systems. Each line card typically includes a microprocessor for controlling the line card. Boot code for the microprocessor is generally stored in a non-volatile memory for the line card so that it is available when the line card is activated. The boot code loads an executable file into the microprocessor's memory. The executable file may also be stored in a non-volatile memory for the line card or downloaded to the line card while running the boot code.

Disadvantages associated with storing boot code in a non-volatile memory for activating a line card include higher space requirements for the line card components, increased routing complexity and higher bill of materials costs. Another disadvantage is the loss of software resources needed to develop and track the boot code as a complete software design. Also, the boot code may contain hidden software bugs.

Recently, executable files for line cards have been provided by a common switch card, which downloads an executable file to a line card without using boot code. However, this method requires every switch card to be updated and maintained in order to provide the appropriate version of an executable file to a line card. In addition, the form of memory used in the switch card is relatively expensive, and the number of line card types which may be supported in this way is limited by the amount of memory available on the switch card.

SUMMARY OF THE INVENTION

In accordance with the present invention, a method and system for activating a line card are provided that substantially eliminate or reduce disadvantages and problems associated with previously developed systems and methods. In particular, the executable file for a line card is directly loaded into the card's microprocessor memory from a dedicated download card, remote server or other suitable element in order to eliminate the need for boot code and for a non-volatile memory on the line card.

In one embodiment of the present invention, a method is provided for activating a card in a network element comprising one or more switch cards. The method includes determining a type of the card. An executable file stored remotely from the card and switch cards is retrieved based on the type of the card. The executable file is downloaded to a memory for a processor on the card without using boot code on the card. The card is operated using the executable file.

In another embodiment of the present invention, a line card is provided for a network element comprising one or more line cards. The line card includes a processor, a memory and an activation system. The memory is associated with the processor. The activation system is operable to identify the line card to the network element, to hold the processor while the network element downloads an executable file for the line card to the memory without using boot code on the line card, and to release the processor subsequent to the downloading of the executable file. The processor is operable to operate the line card using the executable file.

Technical advantages of the present invention include providing an improved method for activating a line card in a telecommunications network. In particular, a dedicated download card, or other suitable element, downloads an executable file to a memory for the line card while a processor for the line card is prevented from accessing the memory. As a result, boot code for the line card does not need to be developed and tracked as a complete software design because no boot code is required. Therefore, the use of software resources is reduced and the potential for hidden software bugs in the boot code is eliminated.

Another technical advantage of the present invention includes providing an improved line card. In particular, the line card may be provided without a non-volatile memory. Accordingly, space requirements for components in the line card and routing complexity and bill of materials costs for the line card are reduced.

Yet another technical advantage of the present invention includes providing an improved method for providing an executable file for a line card. In particular, the executable file is stored in a central location and loaded into the line card's memory upon activation. As a result, the most updated version of the executable file is provided to the line card each time the card is activated or reset, and the executable file may be maintained and updated much more efficiently and cost-effectively.

Other technical advantages will be readily apparent to one skilled in the art from the following figures, description, and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the present invention and its advantages, reference is now made to the following description taken in conjunction with the accompanying drawings, wherein like numerals represent like parts, in which:

FIGURE 1 is a block diagram illustrating a network element for a telecommunications network in accordance with one embodiment of the present invention;

FIGURE 2 is a state diagram illustrating states of the line card of FIGURE 1 in accordance with one embodiment of the present invention; and

FIGURE 3 is a flow diagram illustrating a method for activating the line card of FIGURE 1 in accordance with one embodiment of the present invention.



DETAILED DESCRIPTION OF THE INVENTION

FIGURE 1 is a block diagram illustrating a system 10 comprising a network element 12 for a telecommunications network. The telecommunications network is a network that transmits voice, audio, video or other suitable types of information, and/or a combination of different types of information between source and destination points. The telecommunications network comprises one or more network elements 12, each of which comprises a switch core 14, a plurality of line cards 16, and a download card 18. The switch core 14 comprises one or more discrete switch cards 20.

The network element 12 may be part of an integrated access device that transmits data to and receives data from customer premise equipment, such as standard telephones, modems, computers, data phones and other devices capable of generating traffic for transmission in the telecommunications network. In accordance with one embodiment of the present invention, the integrated access device is implemented in a card shelf configuration with functionality of the device distributed between discrete cards 16, 18 and 20 connected over a back plane. The back plane includes a plurality of slots. The slots include receptors for receiving one or more line cards 16, at least one download card 18, and one or more switch cards 20. The back plane also includes one or more transmission buses for connecting the cards 16, 18 and 20. It will be understood that other types of access devices may be used in connection with the present invention.

The line cards 16, the download card 18, and the switch card 20 are each a discrete card configured to plug

into the back plane. The cards 16, 18 and 20 each include logic stored in a computer-processable medium. The logic may be encoded in hardware and/or software instructions stored in RAM, ROM and/or other suitable computer-readable media for performing the functions associated with the cards 16, 18 and 20. As used herein, each means every one of at least a subset of the identified items.

Referring to FIGURE 1, the switch core 14 switches traffic between the line cards 16, which transmit and receive customer traffic in the telecommunications network.

The switch core 14 may be any suitable telecommunications switch capable of routing voice or other data traffic. According to one embodiment, the switch core 14 performs synchronous-based switching such as time-division multiplex (TDM) switching and cell-based switching based on a synchronized frame pulse. TDM-based switching provides time slot interchange for telephony connections, SONET SPEs, other synchronized traffic, and asynchronous traffic segmented into time slots. The cell-based switching switches asynchronous transport mode (ATM) cell traffic, ATM adaption layer cell traffic, and segmented packet traffic on a frame-based schedule. The switch core 14 may also convert traffic between the TDM and ATM realms to establish cross-connections between the line cards 16.

The switch core 14 receives and processes the TDM and ATM traffic using TDM-based switching and ATM cell-based switching. In switching service traffic received from the line cards 16, the switch core 14 performs queue management as well as broadcast and multicast operations. It will be understood that the line cards 16 and switch core 14 may each perform additional or different functions. It will be

further understood that identified functions of the line cards 16 and the switch core 14 may be suitably off-loaded to the other.

In accordance with one embodiment, the switch card 20 provides functions such as master control, switching, communication within and outside of the network element 12, data storage, and the like. The switch card 20 performs these functions with a processor 22. Communication between the switch card 20 and the line card 16 may be provided through a line card communication interface 24. In one embodiment, this communication is provided over a time slot bus 26.

The line cards 16 allow features and capacity to be incrementally added to the system 10. Each line card 16 comprises a processor 30, a memory 32 for the processor 30, and activation logic 34. The processor 30 controls operations for the line card 16. During activation, as described in more detail below, the processor 30 may be held by suspension, shut down, or held by other suitable means in order to allow loading of an executable file into the memory 32. The memory 32 may store data while power is being provided to the line card 16. The memory 32 may be RAM, other volatile memory with fast access rates, or other suitable memory. The activation logic 34 provides data to the memory 32 for storage. The activation logic 34, which may comprise a state machine, may be implemented in an application-specific integrated circuit, a field-programmable gate array, discrete logic, software and the like. For the embodiment in which the activation logic 34 is implemented in a field-programmable gate array, software for the activation logic 34 may be downloaded by the

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this embodiment due to the distance between the remote server 50 and the network element 12.

FIGURE 2 is a state diagram illustrating states 202 and 204 in which the line cards 16 may be placed in accordance with one embodiment of the present invention. Each line card 16 is placed in the reset state 202 when activated, reset, etc. While in the reset state 202, the processor 30 of the line card 16 is held and thus prevented from accessing the memory 32. The line card 16 transmits to the download card 18 a present message to indicate that the line card 16 is present in the network element 12 and powered up and a reset message to indicate that the line card 16 is in the reset state 202. According to one embodiment, the present message and the reset message each comprise a specified bit of data communicated over the bus 46 that is changed from either a logic low to a logic high or a logic high to a logic low.

The line card 16 also transmits an identifier message to the download card 18 to identify the type of line card 16 and thus the appropriate executable file 48 for loading into the line card 16 during activation. The line card 16 receives the executable file 48 from the download card 18 and the activation logic 34 stores the executable file 48 in the memory 32. The line card 16 waits for a release message from the download card 18, at which point the line card 16 transitions from the reset state 202 to the released state 204.

While in the released state 204, the processor 30 of the line card 16 operates normally and has access to the memory 32. The line card 16 no longer transmits a reset message to the download card 18. Communication is

established between the line card 16 and the switch card 20. The line card 16 remains in the released state 204 until reset by either processor 22 or 30, by a power glitch, or for other suitable reasons.

5       FIGURE 3 is a flow diagram illustrating a method for activating a line card 16 in a telecommunications network in accordance with one embodiment of the present invention. Although the illustrated embodiment is implemented with a download card 18, it will be understood that the method may  
10 also be implemented with a switch card 20 comprising the protocol engine 40 without departing from the scope of the present invention.

The method begins at step 300 where a line card 16 is plugged into a slot in the back plane of the network  
15 element 12. At step 302, the line card 16 is powered up. At step 304, the line card is automatically put into the reset state 202 in response to being powered up.

In step 306, the line card 16 transmits a present message to the download card 18 to indicate that it is  
20 present in the network element 12 and powered up. In step 308, the line card 16 transmits a reset message to the download card 18 to indicate that the line card 16 is in the reset state 202. In step 310, the line card 16 transmits an identifier message to the download card 18,  
25 which receives the present, reset and identifier messages in step 312. It will be understood that any combination of the present message, the reset message and the identifier message may be provided in a single message, as opposed to separately.

30       In step 314, the download card 18 retrieves an executable file 48 for the line card 16 based on the

identifier message transmitted by the line card 16. As described above, the executable file 48 may be stored either in the memory 44 of the download card 18 or in a remote server 50. In step 316, the download card 18  
5 downloads the executable file 48 directly to the memory 32 or directly through the activation logic 34 of the line card 16. In step 318, the activation logic 34 stores the executable file 48 in the memory 32 of the line card 16.

In step 320, the download card 18 transmits a release  
10 message to the line card 16 to indicate that the entire executable file 48 has been downloaded. In step 322, the line card 16 transitions to the released state 204 for normal operations.

Thus, once the line card 16 transitions to the  
15 released state 204, allowing the processor 30 to access the memory 32, the appropriate executable file 48 has been stored in the memory 32. Therefore, the line card 16 is activated without the need for a non-volatile memory to store boot code or executable files 48 for the processor  
20 30.

Thus, the cost of the line card 16 is reduced by eliminating non-volatile memory for storing code. Also, eliminating this memory provides more space for additional components on the line card 16 and reduces routing  
25 complexity. In addition, the line card 16 receives the most updated version of an executable file 48 each time the file 48 is loaded, and the executable file 48 may be maintained and updated much more efficiently and cost-effectively.

30 Although the present invention has been described with several embodiments, various changes and modifications may

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WHAT IS CLAIMED IS:

1. A method for activating a card in a network  
element comprising one or more switch cards, the method  
5 comprising:

determining a type of the card;

retrieving an executable file stored remotely  
from the card and switch cards based on the type of the  
card;

10 downloading the executable file to a memory for  
a processor on the card without using boot code on the  
card; and

operating the card using the executable file.

15 2. The method of Claim 1, the memory comprising a  
volatile memory.

3. The method of Claim 1, downloading the executable  
file to a memory for a processor on the card without using  
20 boot code on the card comprising holding the processor  
while downloading the executable file and releasing the  
processor subsequent to downloading the executable file.

4. The method of Claim 3, holding the processor  
25 comprising holding the processor with a state machine and  
releasing the processor comprising releasing the processor  
with the state machine.

5. The method of Claim 4, the state machine  
30 comprising a field-programmable gate array.

6. The method of Claim 4, the state machine comprising an application-specific integrated circuit.

7. The method of Claim 4, the state machine  
5 comprising discrete logic.

8. The method of Claim 1, further comprising providing a dedicated download card operable to retrieve the executable file and download the executable file.  
10

9. The method of Claim 8, further comprising transmitting a present message for the card to the download card.

10. The method of Claim 8, further comprising transmitting a reset message for the card to the download card.  
15

11. A system for activating a card in a network element comprising one or more switch cards, the system comprising:

5 a line card comprising a processor and an associated memory;

10 a common card operable to communicate with a plurality of line cards and operable to determine a type for the line card, to retrieve an executable file for the line card based on the type of the line card, the executable file stored remotely from the line card and the common card, and to download the executable file to the memory on the line card without using boot code on the line card; and

15 the processor operable to operate the line card using the executable file.

12. The system of Claim 11, the memory comprising a volatile memory.

20 13. The system of Claim 11, further comprising a state machine operable to hold the processor while downloading the executable file and to release the processor subsequent to downloading the executable file.

25 14. The system of Claim 13, the state machine comprising a field-programmable gate array.

15. The system of Claim 13, the state machine comprising an application-specific integrated circuit.

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16. The system of Claim 13, the state machine comprising discrete logic.

17. The system of Claim 11, the common card  
5 comprising a dedicated download card.

18. The system of Claim 11, the common card comprising a switch card.

10 19. The system of Claim 11, further comprising a server remote from the common card, the server comprising a memory operable to store the executable file.

20. A line card for a network element comprising one or more line cards, the line card comprising:

a processor;

a memory associated with the processor;

5 an activation system operable to identify the line card to the network element, to hold the processor while the network element downloads an executable file for the line card to the memory without using boot code on the line card, and to release the processor subsequent to the  
10 downloading of the executable file; and

the processor operable to operate the line card using the executable file.

21. The line card of Claim 20, the memory comprising  
15 a volatile memory.

22. The line card of Claim 20, the activation system comprising a state machine.

20 23. The line card of Claim 22, the state machine comprising a field-programmable gate array.

24. The line card of Claim 22, the state machine comprising an application-specific integrated circuit.  
25

25. The line card of Claim 22, the state machine comprising discrete logic.

26. A system for activating a card in a network element comprising one or more switch cards, the system comprising:

5 logic stored on at least one computer-processable medium;

10 the logic operable to determine a type for the card, to retrieve an executable file for the card based on the type of the card, the executable file stored remotely from the card and the switch cards, and to download the executable file to the memory on the card without using boot code on the card.

27. The system of Claim 26, the memory comprising a volatile memory.

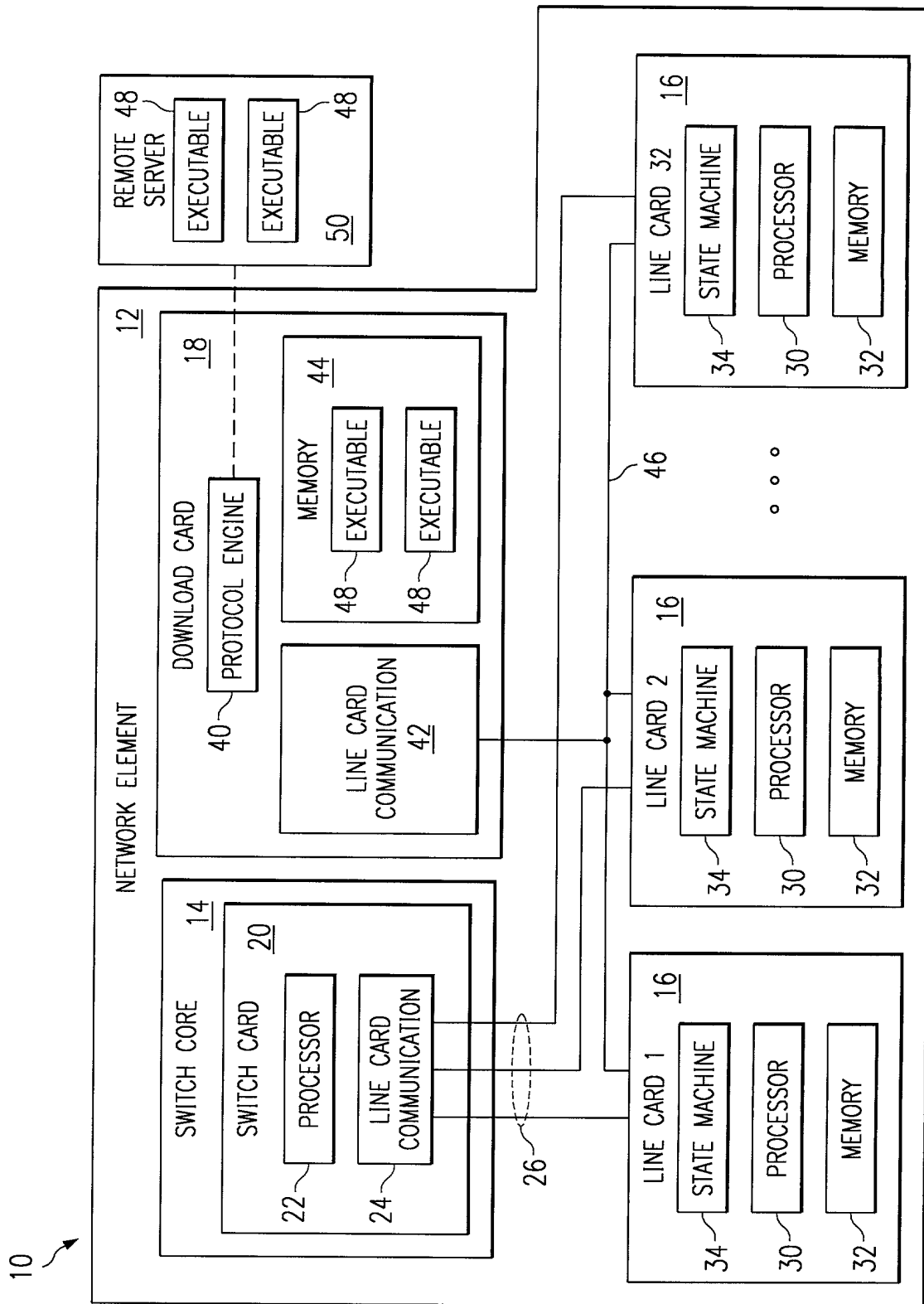
15 28. The system of Claim 26, the logic comprising software instructions.

METHOD AND SYSTEM FOR ACTIVATING A LINE CARD

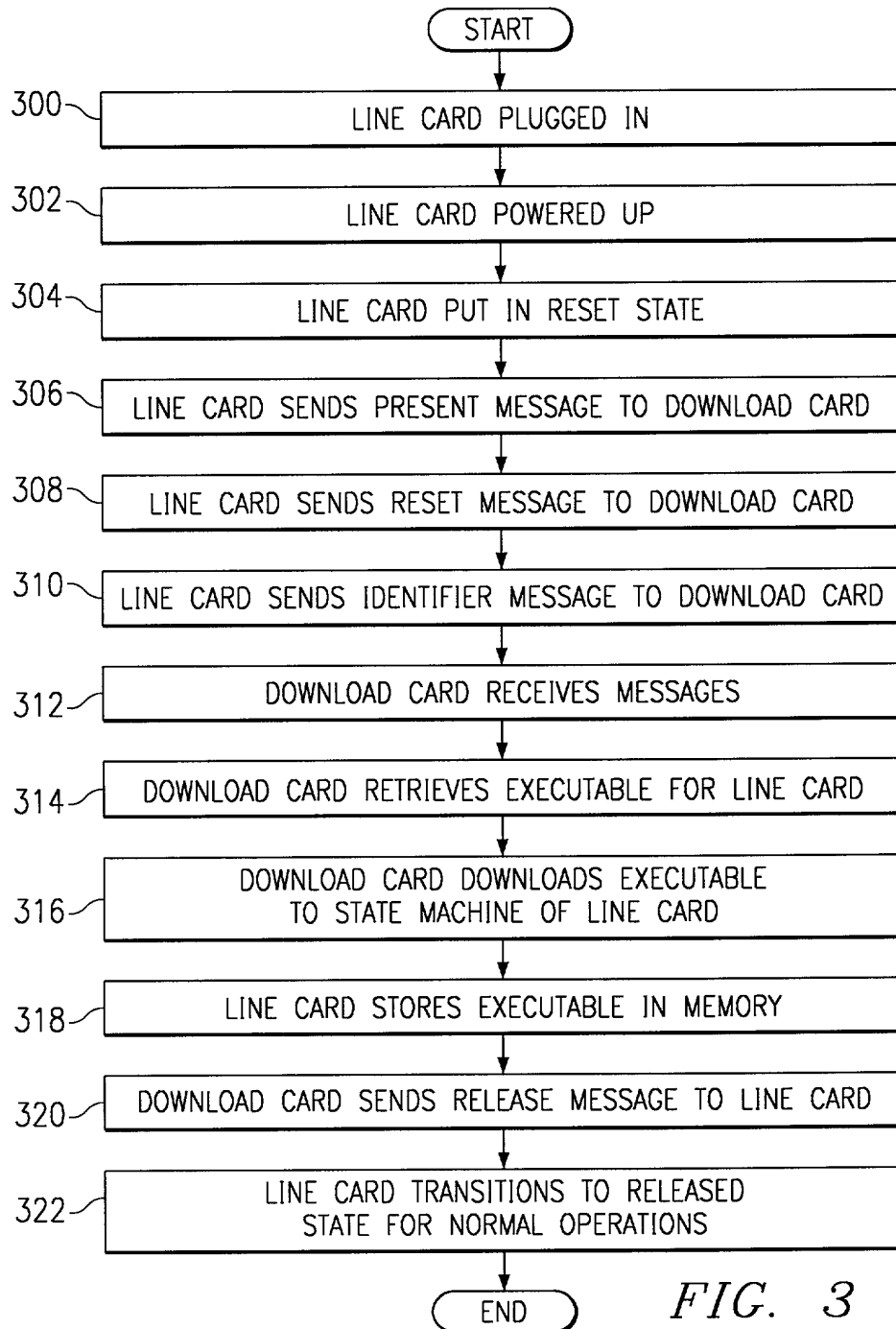
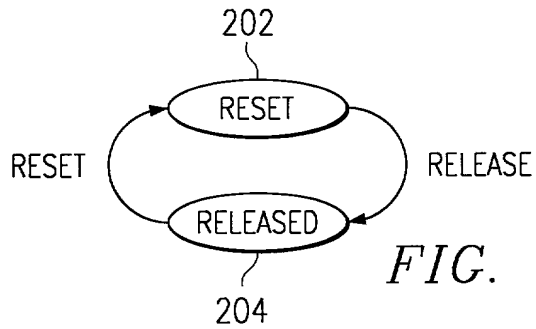
ABSTRACT OF THE DISCLOSURE

5 A method is provided for activating a card in a network element comprising one or more switch cards. The method includes determining a type of the card. An executable file stored remotely from the card and switch cards is retrieved based on the type of the card. The executable file is downloaded to a memory for a processor on the card without using boot code on the card. The card is operated using the executable file.

10







DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I declare that:

My residence, post office address and citizenship are as stated below next to my name; that I believe I am the original, first and sole inventor of the subject matter which is claimed and for which a patent is sought on the invention or design entitled METHOD AND SYSTEM FOR ACTIVATING A LINE CARD, the specification of which

  X   is attached hereto; or

           was filed on        as Application Serial No.            and was amended on                                    (if applicable);

that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above; and that I acknowledge the duty to disclose to the U.S. Patent and Trademark Office all information known to me to be material to patentability as defined in 37 C.F.R. § 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. § 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application(s) for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

| <u>Number</u> | <u>Country</u> | <u>Date<br/>Filed</u> | <u>Priority<br/>Claimed<br/>(Yes) (No)</u> |
|---------------|----------------|-----------------------|--|
|---------------|----------------|-----------------------|--|

-----NONE-----

I hereby claim the benefit under 35 U.S.C. § 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application(s) in the manner provided by the first paragraph of 35 U.S.C. § 112, I acknowledge the duty to disclose to the U.S. Patent and Trademark Office all information known to me to be material to patentability as defined in 37 C.F.R. § 1.56 which became available between the filing date of the prior application(s) and the national or PCT international filing date of this application:

| <u>Application<br/>Serial Number</u> | <u>Date Filed</u> | <u>Status</u> |
|--------------------------------------|-------------------|---------------|
|--------------------------------------|-------------------|---------------|

-----NONE-----

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all of the firm of Baker Botts L.L.P., my attorneys with full power of substitution and revocation, to prosecute this application and to transact all business in the United States Patent and Trademark Office connected therewith and to file and prosecute any international patent

applications filed thereon before any international authorities under the Patent Cooperation Treaty.

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at 214.953.6477  
Attorney Docket No. 062891.0390

I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Full name of sole inventor

E. Barton Manchester

Inventor's signature

E. Barton Manchester

Date

5-24-00

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Citizenship

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